



## Center-wide Procedures and Guidelines (PG)

**DIRECTIVE NO.** 800-PG-8710.3.1  
**EFFECTIVE DATE:** June 26, 2014  
**EXPIRATION DATE:** June 26, 2020

**APPROVED BY Signature:** Original Signed by  
**NAME:** David L. Pierce  
**TITLE:** Director, Wallops Flight Facility

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### COMPLIANCE IS MANDATORY

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**Responsible Office:** 800/Suborbital and Special Orbital Projects Directorate

**Title:** Wallops Flight Facility Flex Hose Handling and Installation

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## PREFACE

### P.1 PURPOSE

This document establishes requirements for the procurement, testing, identification, installation, and use of Flex Hose Assemblies at the Wallops Flight Facility (WFF), its component facilities, field sites, and campaign locations. It defines the methods and procedures, by which personnel will procure, maintain, inspect, install, use, and test all types of flexible hoses.

### P.2 APPLICABILITY

These requirements apply to all uses of flex hoses at WFF (whether NASA managed or tenant owned and operated) or under the auspices of WFF elsewhere. These requirements are imposed on tenants, contractors, experimenters, and external customers only to the extent indicated in their relevant agreements or contracts. Compliance at WFF managed facilities, field sites, and component facilities by tenants, contractors, experimenters, and external customers may be accomplished by analogous procedures if the procedures are at least as stringent and approved as equivalent by the Pressure Systems Manager (PSM). These requirements apply to all ground based flex hoses used to transport hazardous or toxic liquids or gases, cryogenics, and to all ground based flex hoses which are greater than ½ inch Inside Diameter (ID) and are used at above 150 psig, regardless of commodity. Flex hoses contained in systems approved by Underwriter's Laboratory (UL), National Institute for Occupational Safety and Health (NIOSH), or other safety certifying organizations are also excluded provided they are used as certified.

There is a 90 day grace period following the initial release of this document, and all subsequent revisions, to allow for implementation of the requirements.

### P.3 AUTHORITY

- a. NPD 8710.5, Policy for Pressure Vessels and Pressurized Systems
- b. NASA-STD-8719.17, NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems (PV/S)
- c. GPR 8710.3, Certification and Recertification of Ground Based Pressure Vessels and Pressurized Systems

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## **P.4 REFERENCES**

- a. NASA-STD-8719.17, NASA Requirements for Ground-Based Pressure Vessels and Pressurized Systems (PV/S)
- b. GSFC-SH-HPST, Basic High Pressure Systems Training

## **P.5 CANCELLATION**

N/A

## **P.6 SAFETY**

General hazards associated with the use of flex hoses are identified in this document and mitigations are contained in the requirements prescribed by this document.

## **P.7 TRAINING**

Personnel using flex hoses defined as a Type I or Type II flex hose shall receive general pressure systems safety awareness and job specific or “On the Job” training as documented by their supervisor. This general pressure systems safety training must include GSFC-SH-HPST, the GSFC-Basic High Pressure Systems Training course offered through System for Administration, Training, and Educational Resources for NASA (SATERN) as an instructor led course. Alternative training may be submitted for review and approval by the PSM or designee on a case-by-case basis to satisfy the general pressure systems safety awareness training.

## **P.8 RECORDS**

No unique records are generated as a result of this PG.

## **P.9 MEASUREMENT/VERIFICATION**

N/A

## **PROCEDURES**

In this document, a requirement is identified by “shall,” a good practice by “should,” permission by “may” or “can,” expectation by “will,” and descriptive material by “is.”

### **1.0 ACCEPTANCE CRITERIA**

All newly fabricated flex hose assemblies shall meet the following criteria:

#### **1.1 Type I Flex Hose Assembly**

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A Type I Flex Hose is a permanently-dedicated hose whose installation and placement are indicated by design-controlled engineering drawings. Once installed, the flex hose is considered to be an integral part of that installation. Type I hoses have an assigned drawing reference designator. Type I hoses shall be accepted and certified as part of the overall pressure system per NASA-STD-8719.17.

The retest requirement shall be determined as part of the system certification and maintenance plan.

#### 1.1.1 Procurement Requirements

Procurement requirements shall be as defined on the Engineering Drawing.

As a minimum, the requirements specified below for a Type II hose shall be satisfied.

### 1.2 Type II Flex Hose Assembly

A Type II Flex Hose is a non-permanently installed and assigned, non-dedicated flex hose whose installation is authorized and controlled by an operations procedure. Hose and certification requirements will be established by the controlling procedure. This is probably the most common type of aerospace hose used in ground-based systems at WFF.

#### 1.2.1 Procurement Requirements

- 1.2.1.1 The hose materials shall be appropriate for the commodity to be transferred (see Appendix C – Material Restrictions).
- 1.2.1.2 The hose rated temperature range shall be appropriate for the expected internal and external temperatures.
- 1.2.1.3 The hose shall have a minimum rated burst pressure of 4 times the Maximum Allowable Working Pressure (MAWP). Four to one (4:1) safety factor
- 1.2.1.4 The hose shall be hydrostatically tested to 1.5 times the MAWP or pneumatically tested at least to 1.1 times the MAWP by the manufacturer and provide a certificate of compliance.
- 1.2.1.5 A metal tag or band shall be attached to the hose by the manufacturer bearing the following information:
  - a. Manufacturer's Name
  - b. Manufacturer's Part Number
  - c. Fabrication Date (Month and Year)
  - d. Hydrostatic/Pneumatic Test Date (Month and Year)
  - e. Rated Working Pressure
  - f. Serial Number, if applicable

#### 1.2.2 Optional New Hose Requirements

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If the requirements of Section 1.2.1 are not available from the manufacturer, or if the hose is internally manufactured, testing shall be performed per Section 1.2.1.4 by a competent test organization approved by the PV/S Manager (PSM) or designee.

The results of Section 1.2.1.4 and data supporting the requirement of Section 1.2.1.3 shall be submitted to the PSM and once accepted; a hose tag will be created and attached.

### **1.3 Type III Flex Hose Assembly**

A Type III Flex Hose Assembly is a utility hose which is not a permanently installed, mobile, or special purpose hose for use with equipment where the normal working pressure is at 150 psig or below and the hose ID is ½” or less. This flex hose assembly may be used for the transport of all media except hazardous/toxic/cryogenic fluids. If the hose does not meet the above definition, then it is by definition a Type II hose.

**NOTE: Shop air hoses are an example of a Type III Flex Hose Assembly. Type III flex hoses will not be discussed further in this document.**

## **2.0 IDENTIFICATION REQUIREMENTS**

### **2.1 Type I Flex Hoses**

Type I flex hoses shall be identified with a metal tag containing the drawing number and the find number or reference designator as specified in the design drawing.

### **2.2 Type II Flex Hoses**

2.2.1 The hose shall have the manufacturers tag affixed to the hose. (See Section 1.2.1.5)

2.2.2 The hose shall have an Identification Tag affixed to the hose containing the information shown in Figure 1. The “PVS Ident. Number” is a unique identifier assigned by the PSM associated with a unique hose and used to track data associated with the hose.

2.2.3 The hose shall have a visual inspection record attached to the back of the Identification Tag by the PVS group. (Figure 2)

The hose shall not be used beyond the listed expiration date.

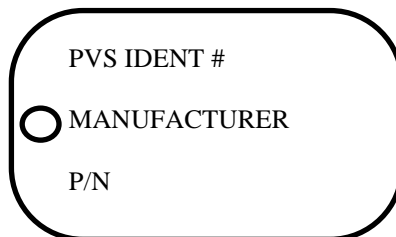
2.2.4 The hose shall have a hose usage tag installed containing the following information (as shown in Figure 3):

- Approved Media (GN2, GHe, BAir, Oxidizers, GOX, N<sub>2</sub> H<sub>4</sub>, etc.)
- Operating Temp Range
- MAWP
- Size (1/2 in x 20ft, ¼ in x 40ft, etc.)

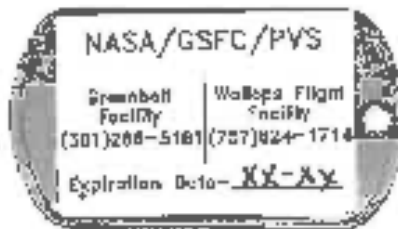
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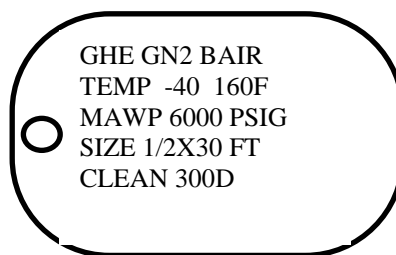
- Cleanliness Level – (500D, 300A, etc.) when applicable



**Figure 1. Hose Identification Tag**



**Figure 2. Visual Inspection Decal**



**Figure 3. Hose Usage Tag**

## **2.3 Requirements for Metal Tags**

2.3.1 Metal tags (dog tags) as required by this document shall be fabricated from stainless steel or aluminum and marked in accordance with Sections 2.2.2 and 2.2.4.

2.3.2 The tags shall have no burrs or sharp edges which could tear or cut personnel or safety clothing such as Self Contained Atmospheric Protective Ensemble (SCAPE) suits.

2.3.3 Tags shall be attached to the flex hose assembly with stainless steel cable or number 16 American Wire Gauge (AWG) stainless steel wire and secured using an aluminum or stainless steel ferrule installed such that there are no exposed wire ends which could puncture skin, clothing, or gloves.

2.3.4 Tags should be installed within approximately 18 inches of each end of the hose. In the event the hose is shorter than 6 feet, the requirement to install tags (2) at each end of the hose is waived and one set of the tags shall be installed roughly in the center of the hose.

2.3.5 When tags or the attaching wires become damaged/frayed/illegible (as applicable), the owner shall repair/replace the tags.

## **3.0 INSPECTION CRITERIA**

### **3.1 Type I Flex Hoses**

The inspection criteria for Type I flex hoses shall be defined within the engineering drawing.

### **3.2 Type II Flex Hoses**

The user shall perform the following inspections each time prior to putting the hose in service:

- Check for broken braid or braid not secured to the end fitting. Broken or unsecured wires are not permitted. If the breaks are due to chafing, locate the source and either reroute, clamp, or use a suitable chafing guard.
- Inspect welded and brazed fittings for cracks, corrosion, or discontinuities. No discrepancies are allowed.
- Inspect all parts of the flex hose assembly for evidence of deformation, flattened areas, cut or broken braid, corrosion, or deterioration. No discrepancies are allowed.
- Verify that the flex hose assembly has all required identification in accordance with Section 2 of this document.
- Verify that the flex hose assembly is identified for the commodity type being transferred.
- Verify the hose Visual Inspection Decal is applied and the hose is within its acceptable inspection life (current date is not after expiration date).

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## **4.0 INSTALLATION**

### **4.1 Type I Flex Hoses**

Type I Flex Hoses shall be installed per the Design Drawing.

### **4.2 Type II Flex Hoses**

#### **4.2.1 General Installation**

The user shall perform the following tasks prior to putting the hose in service:

- a. Verify pre-use inspection per Section 3.2 has been performed.
- b. When required, verify that hoses have been properly controlled for cleanliness and that no visible evidence of contamination exists. Verify the cleanliness level specified on drawings, required in the operations procedure, or specified in the program/project plan has been accomplished and that the hose bears cleanliness certification.
- c. Verify the hose will be used within its allowable temperature range.
- d. Maintain cleanliness control while removing protective caps, plugs, or covers from flex hose and fittings and connecting fittings. Do not reuse caps, plugs, or covers unless they have been verified to be clean.
- e. Ensure the flex hose and fittings and the fitting to which the flex hose is to be connected are free of chips, burrs, dents, nicks, pits, gouges, or foreign material that could endanger proper operation.
- f. Visually inspect welded and brazed fittings for cracks, corrosion, or discontinuities. Inspect end fitting for cracks, tripping, or galled threads.
- g. Verify that all seals and/or sealing surfaces are in good condition. If any defect/deterioration is detected, seals must be changed-out prior to installation.
- h. Teflon tape shall be applied to male pipe thread fittings counter to the direction of tightening, leaving the forward two threads bare.
- i. Lubrication of straight fitting threads shall be accomplished using a minimal amount of Krytox 240 AC or other approved lubricant. Do not allow lubricant to enter flow path. Lubricant shall be applied to male threads only after the respective nut has been started one complete turn.
- j. Install flex hose in a neat and orderly manner and route in a manner that will not place an additional load on the hose or connecting hardware. (Reference Figures 4 through 9)
- k. Avoid sharp bends in the flex hose and ensure that the bend radius is greater than the manufacturer's minimum recommended bend radius. When not specified, the minimum bend radii shall be five (5) times the outside diameter of the hose. (Reference Table 1)
- l. For large diameter flex hose, use transfer line saddles as specified in design drawings to support the hose as applicable.
- m. While ensuring that the flex hose does not turn or twist and, where applicable, using appropriate type and size wrench, tighten to manufacturer's recommended torque. If there is not a torque

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recommended or supplied within the procedure, use torque from Reference Table 2. Use of a backup wrench is recommended on B-nut type fittings.

- n. Perform inspection of assembled hose for twist, kinks, excessive bends, fully secured restraints, and freedom of motion where applicable.

#### 4.2.2 Installation to Flight Vehicle Interface

When flex hoses are routed through vehicle access doors and no equipment exists to provide support and/or protection to the flex hoses, the following guidelines should be used:

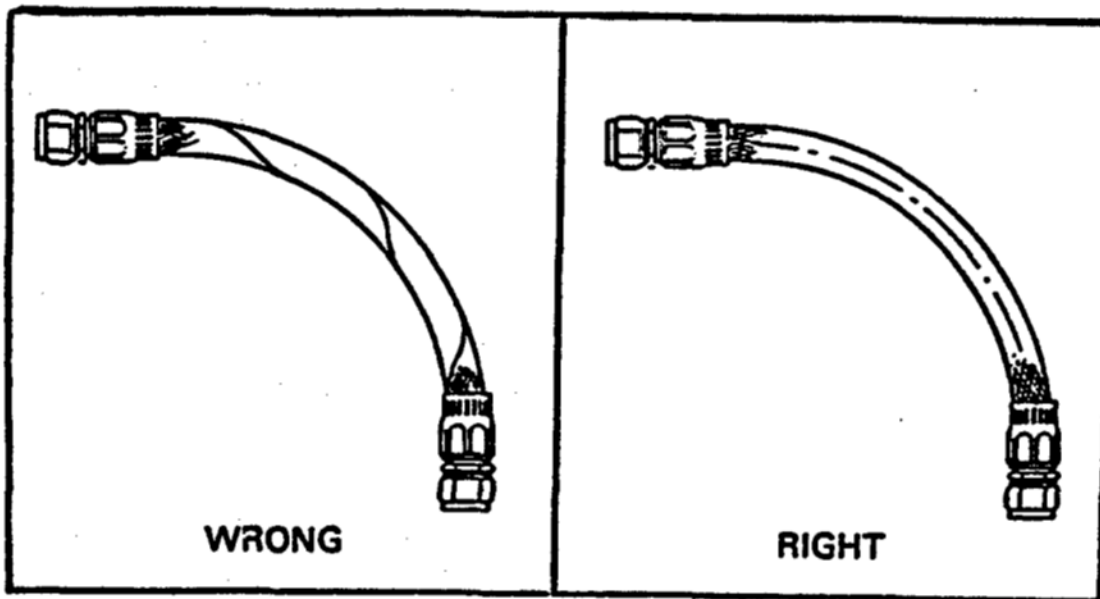
- a. The flex hoses should be secured to the support structure using tie-wraps at approximately 12 inches or as close to the entry point as possible from the point of ingress to the flight vehicle. Wherever possible, flex hoses should be routed to the side or top of the access door/hatch of the flight vehicle.
- b. The flex hoses should be attached starting at the flight vehicle interface and working back to the source and routed through areas of minimal traffic.
- c. Tie-offs to movable platforms should have a “fluorescent orange” tag attached to each tie point to ensure removal prior to platform movement.
- d. Edge protection to the flight vehicle and flex hoses routed through the door or hatch shall be provided.
- e. Vehicle drag-on hoses should include tie-offs as close to the vehicle entry point as is practical and shall be tied to an end point of sufficient strength to resist the forces associated with a failed hose.

**NOTE: Tie-offs are not allowed on tubing, electrical harness, or any sensitive equipment.**

- f. Flex hose routing in or near the flight vehicle should be adequately restrained to protect the vehicle, hoses, and Ground Support Equipment (GSE) from damage and to preclude potential personnel injury.
- g. Routing of flex hoses on the floor is undesirable. Where routing of flex hoses on the floor/platform surface becomes the only viable alternative, covers should be used and/or the area should be roped off for controlled access.

#### 4.2.3 Special Instructions

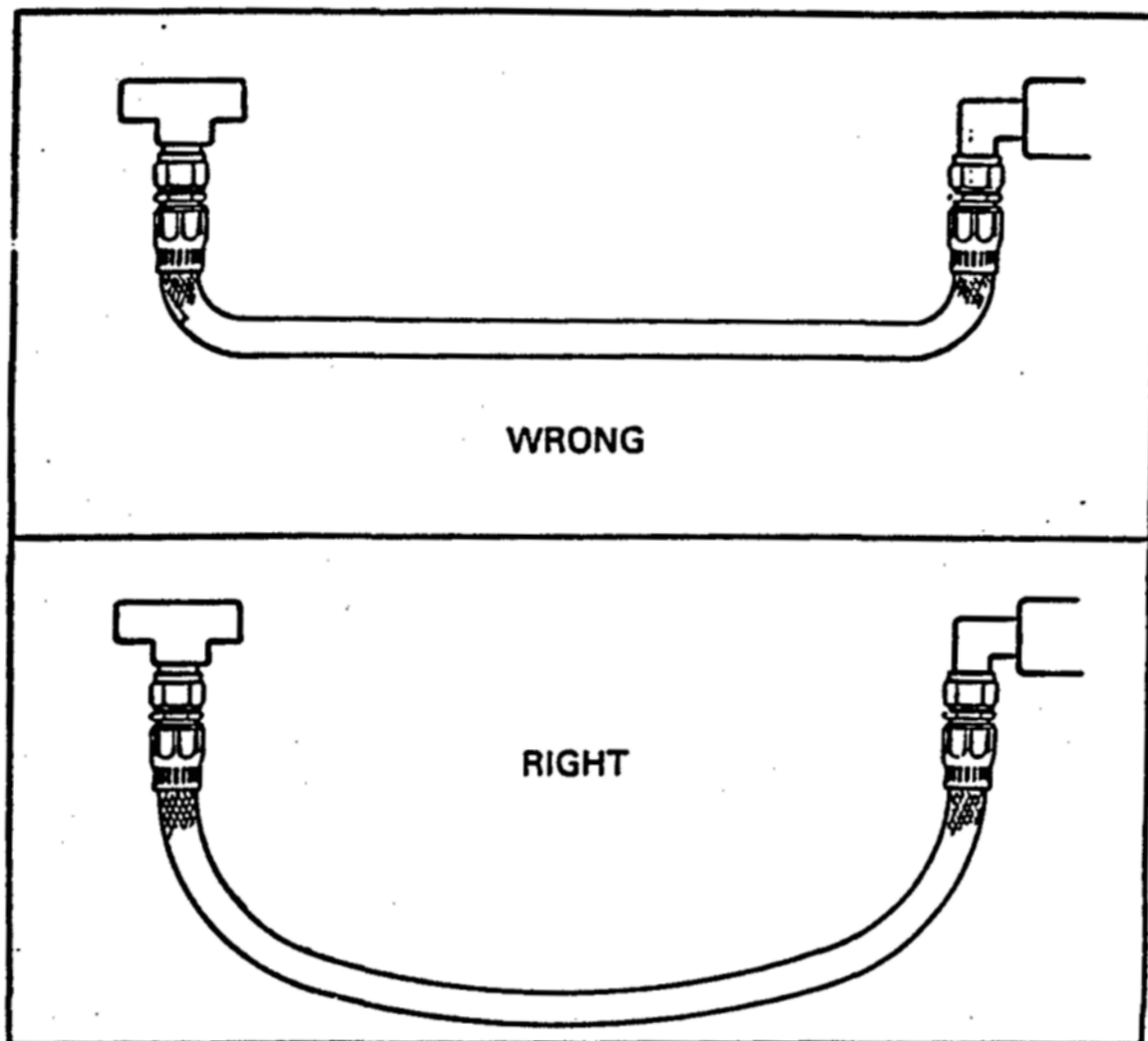
When installing or disconnecting a flex hose from a hardline system resulting in a loose hose end, ensure that the hose end is capped/plugged, properly integrity sealed and secured.



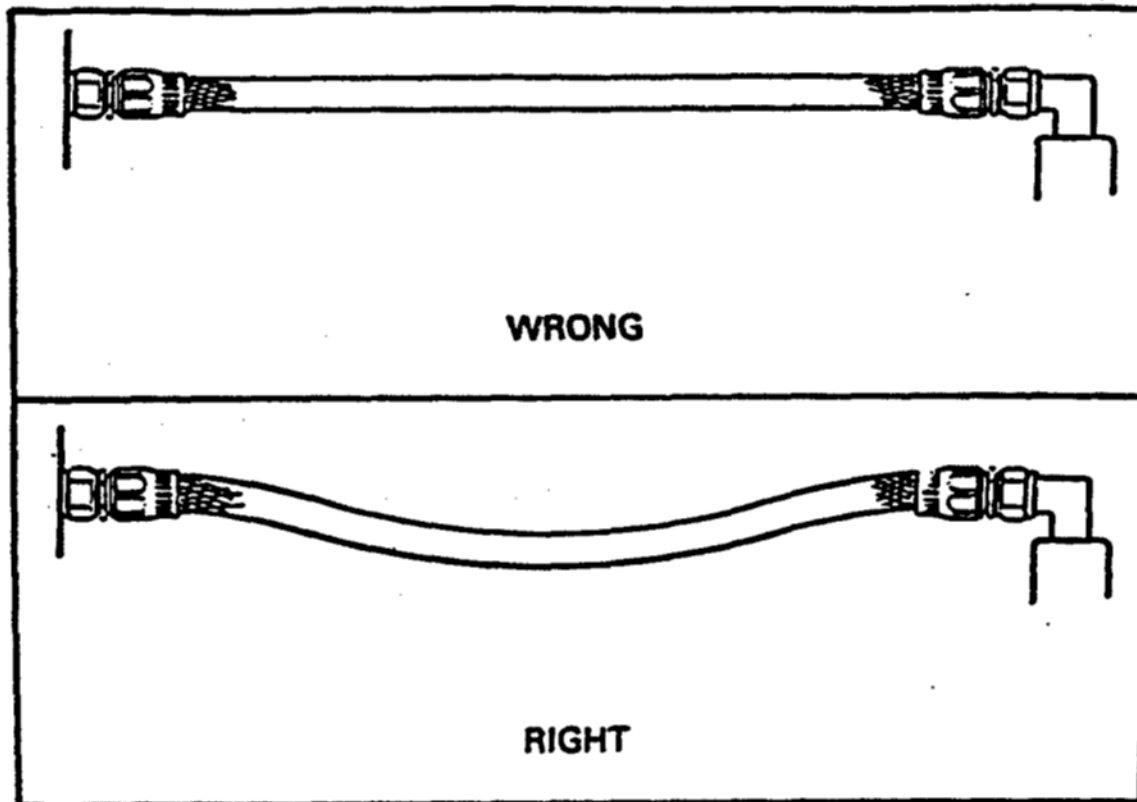
**NOTE:**  
IF HIGH OPERATING PRESSURES ARE APPLIED TO A  
TWISTED HOSE, THE HOSE MAY FAIL OR THE  
ATTACHING NUT MAY BECOME LOOSE.

**Figure 4. Twisted/Untwisted Hose Installation**

**Figure 5. Short/Large Bend Radii Hose Installation**

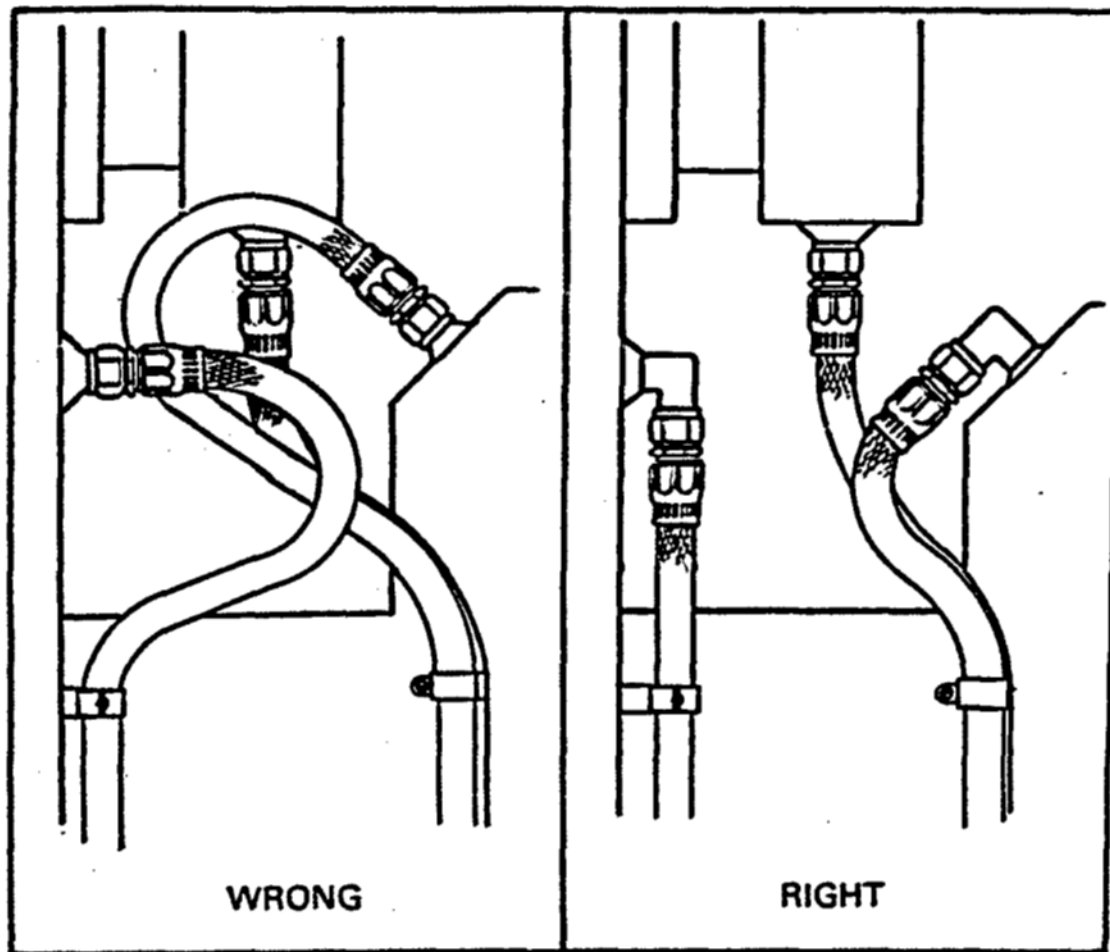


**NOTE:**  
**KEEP THE BEND RADII OF THE HOSE AS LARGE AS NECESSARY TO AVOID KINKING OF LINE AND RESTRICTION OF FLOW, AND CONSISTENT WITH MANUFACTURER'S LIMITATIONS**



**NOTE:**  
REMEMBER THAT THE HOSE WILL CHANGE IN  
LENGTH FROM +2% TO -4% WHEN PRESSURIZED.  
PROVIDE SLACK OR BEND IN THE HOSE TO  
COMPENSATE FOR ANY CHANGES IN LENGTH THAT  
MIGHT OCCUR.

Figure 6. Tight/Slack Hose Installation



**NOTE:**  
USE ELBOWS AND ADAPTERS TO ENSURE  
CLEANER INSTALLATIONS FOR EASY INSPECTION  
AND MAINTENANCE.

Figure 7. Elbow/Adapter Hose Installation Usage

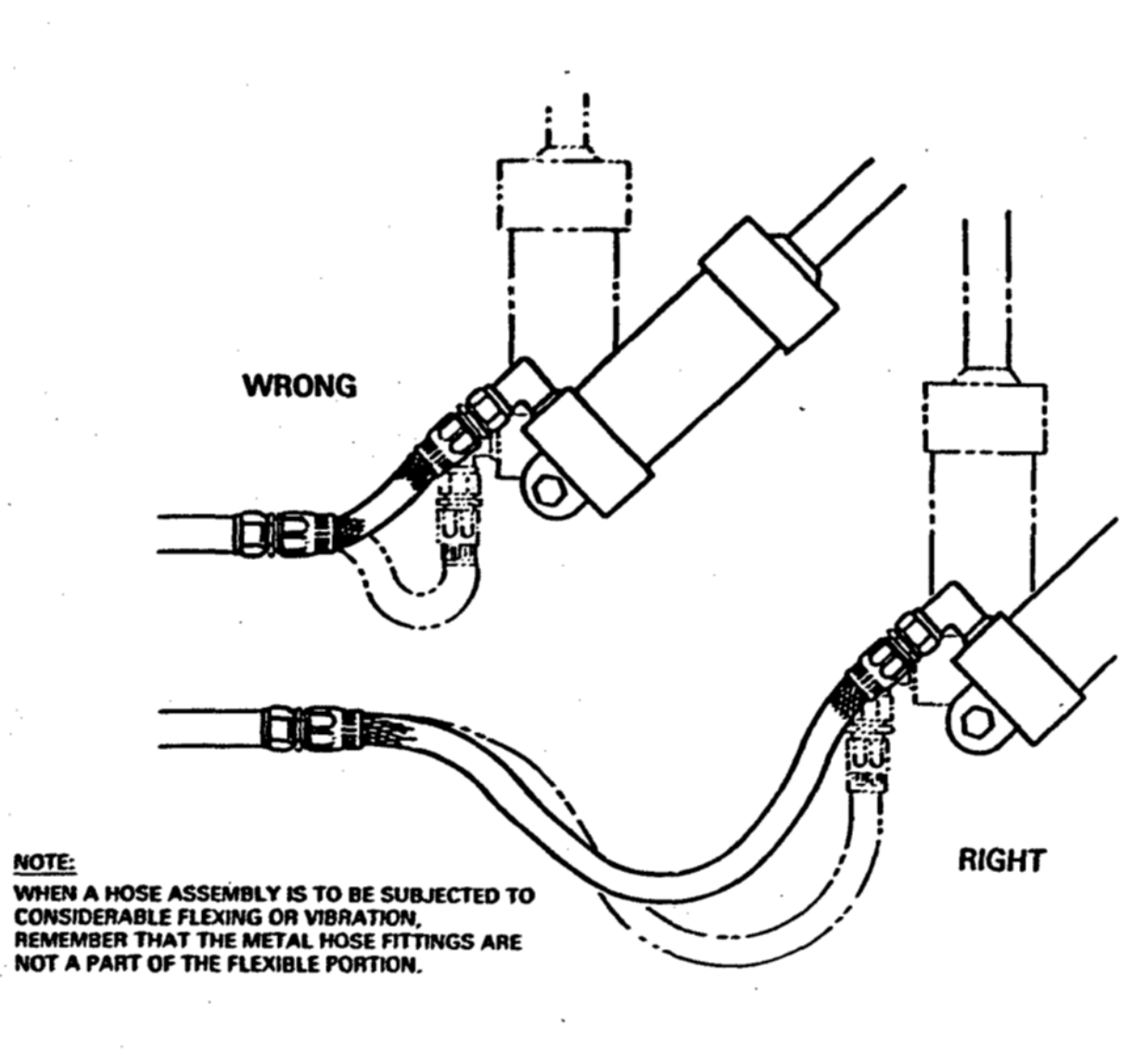


Figure 8. Flexing/Vibrating Hose Installation

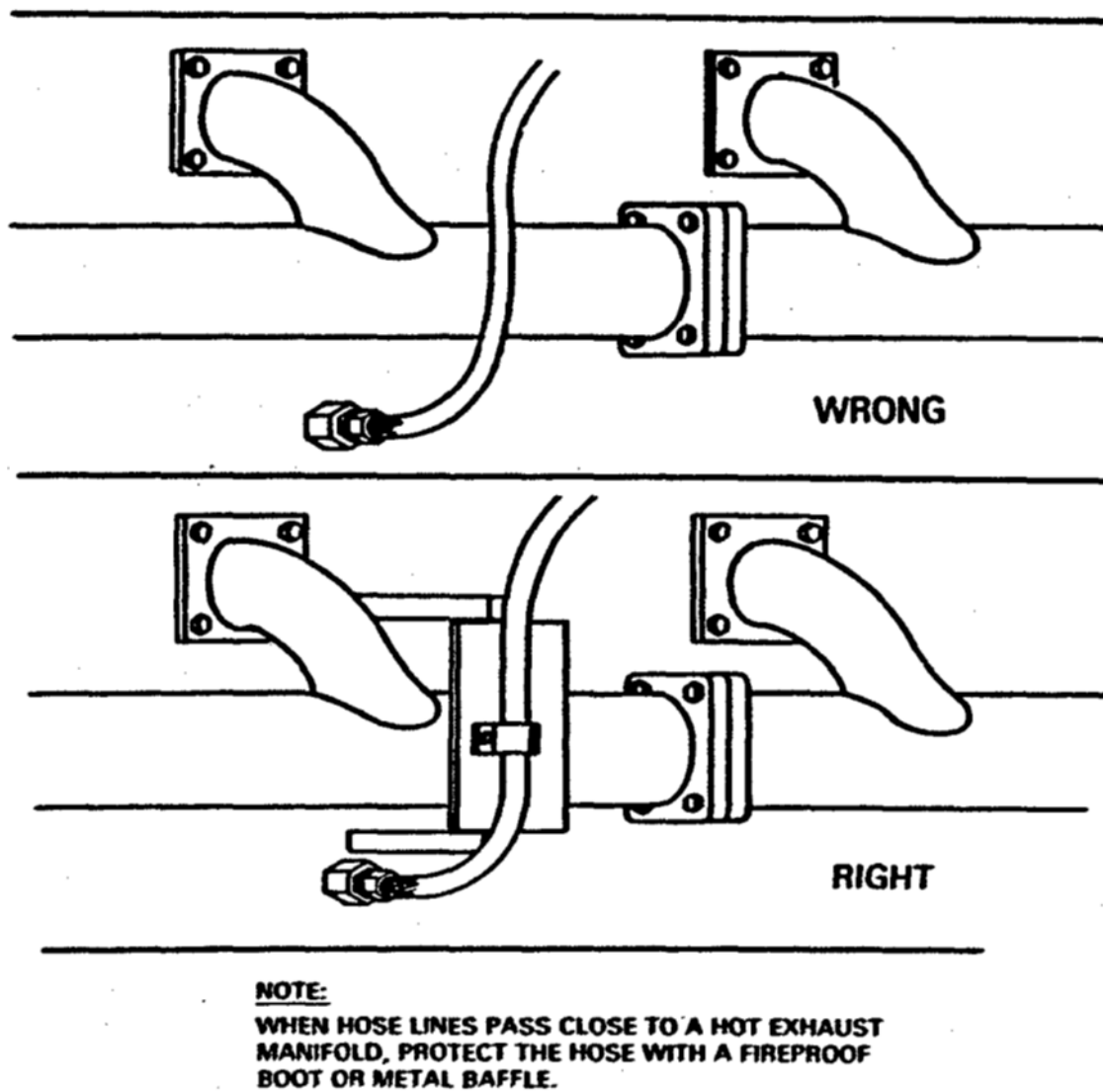


Figure 9. Fireproof/Metal Baffle Hose Installation Usage

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TYPE I AND TYPE II FLEX HOSE MINIMUM BEND RADIUS	
HOSE SIZE (ID INCH)	MINIMUM BEND RADIUS (INCH)
1/4	3
3/8	5
1/2	5-3/4
3/4	7-3/4
1	9-5/8
1-1/4	11
1-1/2	14
2	22

**Table 1 - Flex Hose Minimum Bend Radius**

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FLEXHOSE ASSEMBLY TORQUE VALUES (UP TO 6000 PSIG)		
NOMINAL HOSE SIZE (INCHES)	MINIMUM (INCH-POUNDS)	MAXIMUM (INCH-POUNDS)
3/16	85	145
1/4	135	185
5/16	180	250
3/8	270	345
1/2	450	525
5/8	650	755
3/4	900	1100
1	1200	1400
1-1/4	1500	1800
1-1/2	2000	2300
1-3/4	2580	2880
2	3200	3600

SUPER PRESSURE FLEXHOSE FITTING TORQUE VALUES (6000 PSIG AND GREATER)					
	FITTING SIZE (INCHES)				
	1/4	3/8	9/16	3/4	1
FITTING TYPE	TORQUE RANGE (INCH-POUNDS)				
AMINGO	132-180	264-336	456-540		
AUTOCLAVE CONE	132-168	372-468	600-720		
AUTOCLAVE SLIM-LINE CONE	156-204	240-300	540-660	840-1080	1020-1260

**Table 2 – Flex Hose Fitting Torque Values**

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## 5.0 CONTAINMENT/RESTRAINT AND SAFETY REQUIREMENTS

### 5.1 Type I Flex Hoses

Type I Flex Hoses shall be restrained per the Engineering Drawing requirements.

### 5.2 Type II Flex Hoses

Type II Flex Hoses which are six feet long or greater shall be installed so that restraint is provided on both the hose and adjacent structure at no greater than six- foot intervals and at each end to prevent whipping in the event of a burst.

Restraining devices shall be designed and demonstrated to contain a force not less than 1.5 times the open-line pressure forces. (See Table 3).

The manufacturers rated working load for the restraint shall be at least equal to 1.5 times the open line force working load.

**NOTE:** For example, for a ¼” inside diameter flex hose at 5000 psig, the restraint rating would be  $0.2832 \times 5000 \times 1.5 = 2142$  lbs.

**Do not use hose clamp type restraining devices.**

DIAMETER OPENING (INCH)	CALCULATED FORCE FACTOR FOR EACH PSI OF SOURCE PRESSURE (LB)
1/8	0.18506
1/4	0.2832
3/8	0.3814
1/2	0.4796
5/8	0.5777
3/4	0.6759
7/8	0.7741
1	0.8723
<b>NOTE:</b> To calculate the force acting on line opening, select applicable diameter and multiply righthand column by the source pressure (psi).	

**Table 3 - Open Line Force Calculation Factor**

### 5.2.1 Restraint Types and Limitations on Use

Hose restraint, regardless of type, must be supplied from the manufacturer as hose restraints and not as “pulling grips” or as “support slings”. All flex hose restraints shall be manufactured from stainless steel cable.

Currently, three manufacturers are recognized as supplying acceptable flex hose restraints:

- a. Kellems Division of Hubbell Wiring Devices
- b. American Iron Works, Whip Sock, located in Oklahoma
- c. AMTEK Corporation, Plainfield, CT.

Additional suppliers may be acceptable with PSM review and approval.

#### 5.2.1.1 Containment Style Restraints

This type of restraint can be used with any style or pressure of hose provided the strength requirements of Section 5.2 and Table 3 are met. The manufacturers will request from the user the inside diameter of the hose, the media, and the MAWP of the hose to allow them to size the restraint. The end fittings shown in Figure 10 may not be available from all manufacturers. All containment style hose restraints require the installation of a Stainless Steel worm style hose clamp located within 1 ½ inches of the weave end of the hose restraint (opposite the hose end) and tightened finger tight but less than 25 in-lbs torque.



**TYPE E:** DOUBLE EYE GRIP - USED WHERE FASTENING IS MADE WITH EYE BOLTS OR SIMILAR ANCHOR TERMINATIONS.



**TYPE A:** SINGLE EYE GRIP - USED WHERE FASTENING MUST BE MADE FROM ONE ANCHOR POINT.



**TYPE U:** UNIVERSAL BALE GRIP - USED TO FASTEN AROUND A STRUCTURE OR CLOSED EYE.



**TYPE Y:** THREADED BOLT 5/16-18 x 1-1/2 INCH LONG - USED TO FASTEN THROUGH DRILLED HOLES IN PLATE.

**NOTES:**

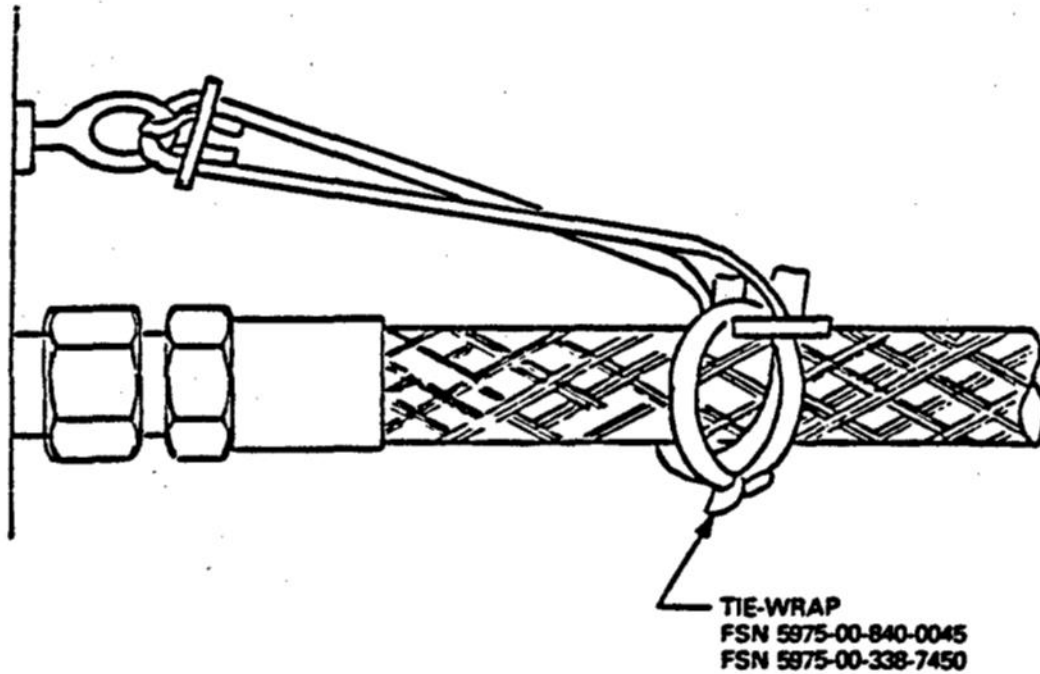
1. PLACE THE ENDLESS WEAVE END OF THE GRIP OVER THE HOSE AND SLIDE THE GRIP PAST THE HOSE FITTING.
2. CONNECT THE HOSE FITTING.
3. POSITION THE GRIP FOR ATTACHMENT TO THE SUPPORTING STRUCTURE AND SECURE GRIP EYE TO STRUCTURE.
4. REMOVE ANY SLACK IN GRIP EYE AND MESH BY SMOOTHING DOWN THE MESH, STARTING FROM THE EYE ATTACHMENT POINT AND WORKING TOWARD THE ENDLESS WEAVE END OF THE GRIP.
5. PLACE THE CLAMP OVER THE ENDLESS WEAVE END WITH APPROXIMATELY 1-1/2 INCH OF MESH BEYOND THE CLAMP. TIGHTEN CLAMP FINGER TIGHT BUT NOT MORE THAN 25 INCH-POUNDS.
6. SAFETY APPROVED FOR ALL HOSE SIZES AND PRESSURE RATINGS.

**Figure10. End Fittings - Containment Style Hose Grips**

#### 5.2.1.2 Universal Bale (sliding bar style).

This type of restraint may be used to confine hose ends and unions where substantial structural attachment points are available and the following limitations are met:

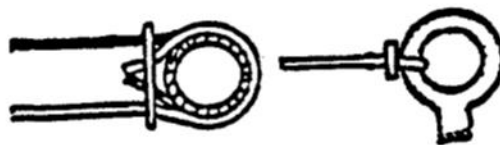
- a. These restrains are prohibited from use on hose sizes less than ½ inch ID at any pressure or any diameter hose above 3000 psig operating pressure.
- b. These restraints may be used on ½ inch ID and larger hoses to a maximum diameter and pressure as follows:
  - ½” ID = 3000 psig maximum
  - ¾” ID = 2150 psig maximum
  - 1” ID = 1650 psig maximum
- c. The bale must be tightly secured to the flex hose by a properly applied tie-wrap, 5/16 inch wide by a minimum of 6 inches long which uses a metallic locking tab (Federal Stock Number (FSN) 5975-C-838-7450 or FSN 5975-00-838-7450 or equivalent). The tie-wrap must pass between the base nipples as they protrude through the keeper bar and around the hose (Reference Figure 11).
- d. The tie-wrap shall be drawn as tight as possible to secure the base cables against the hose. Excess tie-wrap may be cut off and corners chamfered to remove sharp edges. The structural attachment does not need a tie-wrap unless sliding of the base would cause slack in the restraint.
- e. The bale hose attachment bolt shall be between 9 and 11 inches from the hose fitting.
- f. There shall be a minimum amount of slack in the restraint, but it should not be so tight as to introduce a load onto the flex hose. Maximum slack should be 1 inch for every 6 inches of bale.
- g. Reference Figure 12 and Figure 13 for approved restraint installation configuration.
- h. Restraints with bronze keeper bars shall not be used within 25 feet of lines or systems containing ammonia or hypergolic propellants.



**Figure11. Tie-Wrap Installation**



Ends of bale are wrapped around or fed through the object and secured through keyed openings in the sliding bar. Swaged lugs on bale ends lock bales in place.



Kellems Support Sling shown attached to pipe, left. And to closed eye, right. Attachment is quick and secure. Removal is equally simple.

DIM. TO WELDING BARS  
FULLY EXTENDED



#### Working Loads:

Design strengths of new unused Slings are shown below. These strengths are shown for selected diameters ("D" and "d") for objects being held under static load conditions.

Age and condition of the Sling, plus abnormal conditions such as shock loading, determine the safety factor which should be considered.

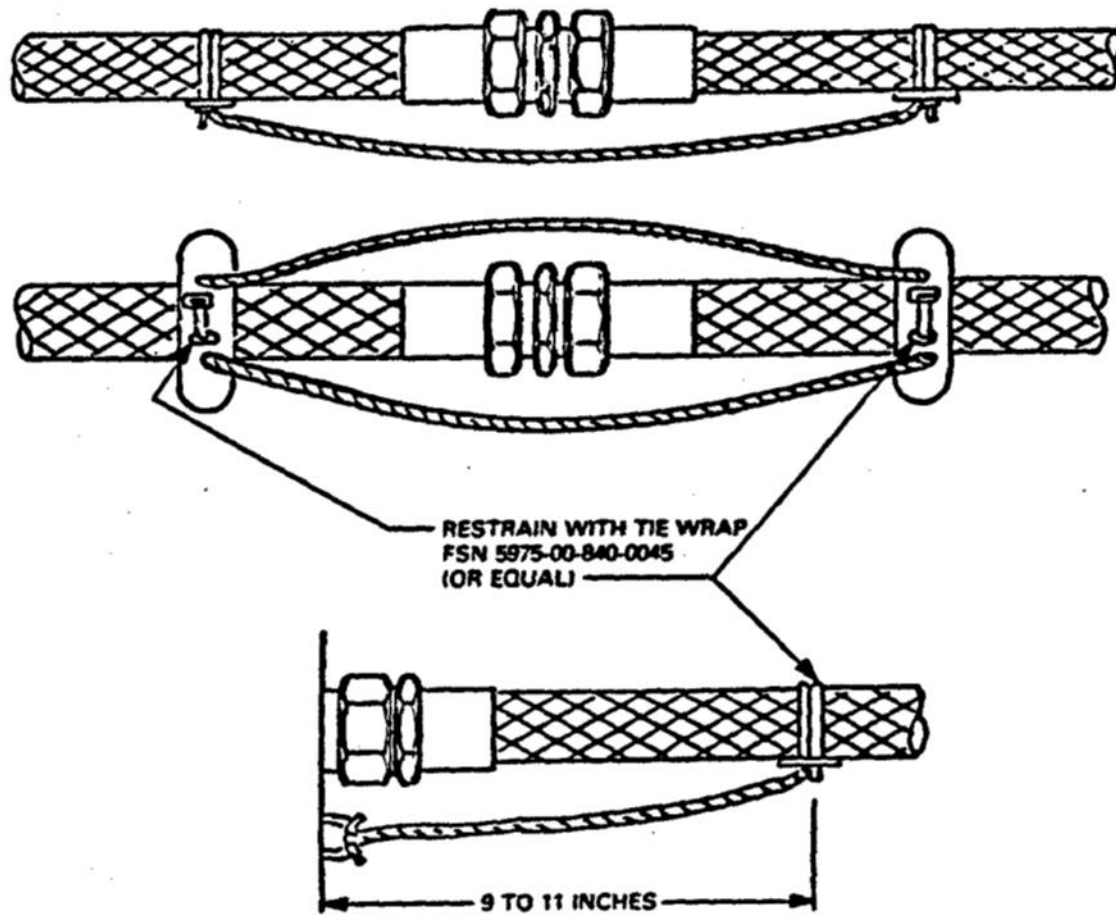
DIAMETER "D" (INCHES)	(DIAMETER "d" INCHES)		
	1/2	1-1/2	4
1/2	2200	2200	2200
1-1/2	2200	3200	3000
4	2200	3000	3000

DESIGN STRENGTH (POUNDS)

STAINLESS STEEL	GALVANIZED STEEL	LENGTH (L NOMINAL)
204-12-001	203-12-001	12"
204-12-005	203-12-005	18"
204-12-002	203-12-002	24"
204-12-003	203-12-003	36"
204-12-004	203-12-004	48"

CATALOG NUMBER

Figure12. Kellems Support Sling (AMTEK Similar)



**NOTES:**

1. SAFETY APPROVED FOR USE WITH HOSE: DIA 1/2-INCH AND ABOVE, PRESS. - UP TO 3,000 PSIG.
2. RESTRAINTS WITH BRONZE COMPONENTS SHALL NOT BE USED WITHIN 25 FEET OF HYPERGOLICS AND AMMONIA FLUIDS.

**Figure 13. Universal Bale Flex Hose Restraint Configuration**

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### 5.2.2 Flex hose Stress

Design flex hose installations so that they shall not produce stress or strain in the hard lines or components beyond their design limits. Include stresses induced because of dimensional changes caused by pressure or temperature variations, or torque forces induced in the flex hose.

### 5.2.3 Temporary Installations

Temporary installations using chains or cables anchored to substantial fixed points, lead ingots or other weights are acceptable providing they meet the strength requirements of Section 5.2 and Table 3. Protect the flex hose from kinking or abrasive chafing from the restraining device or damage from adjacent structures or moving parts that may cause reduction in strength. If anchor points are not available, the hose may be secured with 50-pound sand bags, lead ingots, proof load weights, or other suitable weights at intervals not to exceed 6 feet (two twenty-five pound weights may be used if they are applied at the same point on the hose = 50 pounds). Ensure that the hose is not chafed by the ground and if necessary the hose may be padded with the sand bags.

**NOTE: DO NOT place the lead ingots or proof load weights directly on the hose.**

## 6.0 **TRANSPORTATION AND STORAGE**

### 6.1 Type I Flex Hoses

When not installed into the assembly, transport and store Type I flex hoses in accordance with the requirements for Type II flex hoses.

### 6.2 Type II Flex Hoses

#### 6.2.1 Storage

When storing flex hoses, the following criteria shall apply:

- Flex hoses shall be stored in an indoor protected area with hose coils supported by hangers (not a single point), or lying flat on storage shelves or in drawers. Store hypergol-contaminated flex hoses in the same manner but in designated area approved by the WFF Safety Office.
- Large diameter (greater than 1-1/4 ID) flex hoses shall be stored on racks that support the flex hose at various places along its length.
- Cryogenic flex hoses should be placed in a suitable storage rack that allows maintaining cleanliness and dryness as required for the particular system involved.

#### 6.2.2 Transportation

When transporting flex hoses, the following criteria shall apply:

- Coil the flex hose and secure coils together. Coil radius shall be greater than the rated minimum bend radius (Reference Table 1). Place large diameter hose, such as cryogenic transfer hose, on a flat horizontal surface straight or in the form of a "U".
- Avoid placing any items such as tools, tool boxes, materials, etc., on top of the flex hose.
- Avoid dragging the flex hose on the ground or hard surfaces.

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## Appendix A – Definitions

- A.1 Hydrostatic Test** - A water pressure test of the hose when manufactured and as required thereafter by the design-controlled drawing to verify mechanical integrity and absence of leaks in the hose assembly. The hose must not be damaged or deformed or leak when subjected to its required pressure. The hydrostatic pressure is a minimum of 1 ½ times the hose's maximum allowable working pressure (MAWP) unless otherwise specified by the design-controlled drawing or the manufacturer's specification.
- A.2 Hose Identification Tag and Visual Inspection Tag** - A metal dog tag bearing critical data which allow the hose to be tracked back to the manufacturer and the manufacturer's part number. On the back of the metal tag, a flexible Visual Inspection Tag (decal) is attached which carries the date the hose received a visual inspection and the due date for the next required manual inspection. (Ref. Figure 1 and Figure 2). Per paragraph 2.2.2, a hose Identification Tag contains the following information:
- PVS Issued Identification Tracking Number
  - Manufacturers Name
  - Manufacturers Part Number
- A.3 Hose Usage Tag** - A metal dog tag which provides additional data regarding approved media, operating temp range, MAWP and cleanliness requirements, when applicable. (Reference Figure 3.) The Hose Usage Tag contains the following information:
- Approved Media (GN2, GHe, BAir, Oxidizers, GOX, N<sub>2</sub> H<sub>4</sub>, etc.)
  - Operating Temp Range
  - MAWP
  - Size (1/2 in x 20ft, ¼ in x 40ft, etc.)
  - Cleanliness Level – when applicable
- A.4 Pneumatic Test** - A gas pressure test of the hose to verify mechanical integrity and an absence of leaks in the hose assembly. Such a test is to be performed only as required by special engineering instructions and no less frequently than every 5 years. The hose shall not be damaged or deformed or leak when subjected to 110% of the rated working pressure of the hose..
- A.5 Pressure System** - A system containing a gas or liquid media at greater than or less than ambient pressure. Pressure systems are subject to review and certifications under NASA-STD-8719.17 at all pressures. Specific category exclusions or assessed hazard exclusions may apply (see NASA-STD-8719.17, section 4.2).
- A.6 Reference Designator (Find Number)** - An alphanumeric combination that provides a unique system identification of each flex hose as designated by the applicable design drawing (used for Type I hoses only).

- A.7 Serial Number** - A unique number assigned by the manufacturer to a specific flex hose to provide traceability.
- A.8 System Test** - A leak test of the hose while installed in the system. No leakage is allowed when subjected to the maximum system working pressure.
- A.9 Type I Flex Hose Assembly** - A permanently installed, dedicated hose whose installation and placement are indicated by design-controlled engineering drawings. Once installed, the flex hose is considered to be an integral part of that installation. Type I hoses have an assigned drawing reference designator. Type I hoses shall be certified as part of the overall pressure system per NASA-STD-8719.17 and the retest requirement shall be determined as part of the system certification and maintenance plan.
- A.10 Type II Flex Hose Assembly** – A non-permanently installed and assigned, non-dedicated flex hose whose installation is authorized and controlled by a procedure. Hose identification and operating requirements will be established by the controlling procedure.
- A.11 Type III Flex Hose Assembly** - A utility hose which is not permanently installed, mobile, or special purpose hose for use with equipment where normal working pressure is 150 psig or below. This flex hose assembly may be used for the transport of all media except hazardous/toxic fluids. Shop air hoses are an example of a Type III Flex Hose Assembly. Type III flex hoses that are ½” ID or less, and are used below 150 psig are exempted from these requirements.

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## **Appendix B – Acronyms**

AWG	American Wire Gauge
FSN	Federal Stock Number
GSE	Ground Support Equipment
ID	Inside Diameter
MAWP	Maximum Allowable Working Pressure
NIOSH	National Institute for Occupational Safety and Health
PSM	Pressure Systems Manager
PV/S	Pressure Vessels & Pressurized Systems
SATERN	System for Administration, Training, and Educational Resources for NASA
SCAPE	Self Contained Atmospheric Protective Ensemble
UL	Underwriter's Laboratory

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### **Appendix C – Material Restrictions**

1. Flex hose used for hypergolic fluids shall be permanently dedicated to that commodity shall not be used in any other system.
2. Flex hoses used for hydrogen service shall not contain any 17-4PH stainless steel parts that could come in contact with the media, nor shall 17-4PH stainless steel be specified in any procedure applicable to hydrogen service.
3. Flex hoses used for oxygen service shall be only those specified as being oxygen compatible and shall be dedicated to that commodity. They are prohibited from use in any other system.
4. Flex hoses or containment/restrains made of copper or copper containing materials shall not be used for ammonia or hypergolic fluids.

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## CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	6/26/14	Initial Release
	6/13/19	Administratively extended for 1 year

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